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## **Ar/N<sub>2</sub> Plasma Treatment of High Density Polyethylene via Atmospheric Microwave Plasma Pencil Ion Source Device**

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High density polyethylene substrates were treated with argon-nitrogen plasma via the Atmospheric Microwave Plasma Pencil ion source device. Optical emission spectroscopy results indicated the presence of Nitrogen and Oxygen molecular ions and Argon ions in the plasma. The device's microwave power configuration was varied at an increment of 20W from 40 to 100W and the treatment time was varied from 5 to 60s. Surface free energy ( $\gamma$ ) values were calculated by using the van Oss - Chaudhury – Good equation from the contact angle measurement results of three test liquids namely water, glycerol and ethylene glycol. Generally, higher power and longer treatment time yielded higher  $\gamma$  which is an indication of enhanced adhesion properties. The highest  $\gamma$  obtained is 51.89 mJ/m<sup>2</sup> at 100 W and 60s treatment time. The increase in  $\gamma$  is attributed to the formation of the polar functional groups amine (C-N, N-H) and carbonyl (C=O), which was observed through Attenuated Total Reflectance -Fourier Transform Infrared Spectroscopy. Also,  $\gamma$  is significantly correlated to the root mean square surface roughness and approximated surface area values which were calculated from the Atomic Force Microscopy data.